such as Plagiaulax of the Purbeck and Microlestes of the Trias (!). The author appears, indeed, to consider that, with the exception of Pyrotherium (which, despite its remarkable resemblance to Diprotodon, he places in the proboscidean line), all mammals with a diprotodont type of dentition are related to one another. And he endeavours to show that the dentition of one type passes by imperceptible degrees into that of another. But such gradations may be traced between the dentition of almost any groups, and no allowance whatever is made for parallelism in development, which has undoubtedly been an important factor in evolution. Moreover, no account whatever is taken of the undoubted resemblance existing between the cheek-teeth of the polymastodonts and the reptilian Tritylodon.

Then, again, according to the author's scheme, the true diprotodonts of Australia have no relationship with the polyprotodont marsupials of the same region, which is, on the face of it, an absurdity. It may also be pointed out that Dr. Ameghino takes no account of the work of other palæontologists. It is very generally accepted, for instance, that an intimate relationship exists between marsupials (as a whole) with the extinct creodonts, and so with the modern Carnivora (see Wortman, *Amer. J. Sci.*, vol. xiv., 144, 1902), while Prof. Osborn (*Bull. Amer. Mus.*, xvi. p. 203, 1902) has indicated the probability of the descent of the rodents from the Holarctic Eocene Mixodectidæ. Obviously both these phylogenies must be demonstrated false before there is even a *primâ facie* possibility for Dr. Ameghino's scheme. It will be interesting to learn what the United States palæontologists have to say on the subject when the groups in question come to be treated in the working out of the Hatcher collection. R. L.

GEOLOGICAL NOTES.

OBSERVATIONS have been made by Mr. R. D. Oldham on the growth of sandhills, which threaten to cut off communication between the town of Karachi and the suburb of Clifton, two or three miles distant (*Mem.* Geol. Surv. India, xxxiv., part iii.). He traces out the growth of dunes from small oval patches of sand which begin to accumulate on irregular tracts of the stony surface, pointing out that even a slight accumulation may cause an upward bend of the air currents whereby a space of comparative calm is produced, and sand more readily comes to rest. In course of time the oval patches of sand are heaped up with a sharper slope to leeward, down which the sand grains fall. Here a hollow is produced by an eddy of the wind, and this eddy serves to maintain and increase a crescentic form with a crater-like opening. The principal winds at Clifton blow from W.S.W., and form the main features in the sandhills; but winds from the E.N.E. blow during the winter months, causing a reverse slope and a bank of sand to be formed near the summit of the long gentle slope which faces the W.S.W. winds. There is a good deal of scour of the original steep leeward slope, but no complete reversal of the shape of the sandhill.

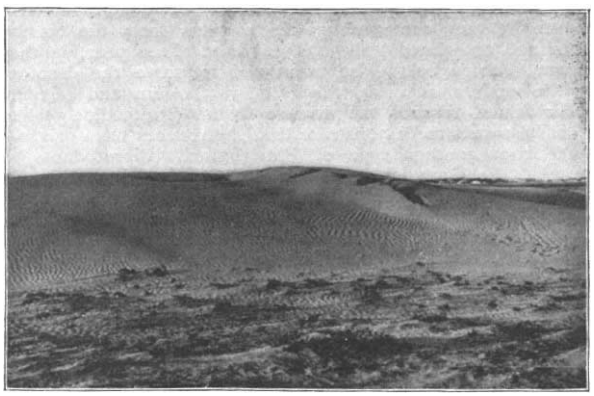

FIG. 1.—Sandhill near Clifton, Karachi, showing change of form and scour by wind.

Mr. Oldham points out that the original hollow is well shown in the accompanying view. The sandhill was first shaped by W.S.W. winds, then a period of E.N.E. winds caused a partial modification of form, heaping up the sand from that side and producing the steep slope facing to left of the picture. The sandhill was afterwards attacked by a S.W. wind, which commenced to reshape it, and this alteration at first led to the formation of notches in the crest, in which the wind became concentrated, leading to a violent scour and to the excavation of deep pits to leeward. The furthest of the notches has been cut down nearly to the foot of the steep slope. Eventually it and the other notches will be widened, and the intervening pinnacles will be lowered until the crest is reduced to a smoothly rounded outline. Mr. Oldham discusses the means which may be taken to arrest the progress of the sandhills, and concludes that much may be done by encouraging the growth of local grasses.

In an essay on the deformation of rocks, Mr. E. H. L. Schwarz (*Trans.* S. African Phil. Soc., xiv., part iv.) discusses their crushing strength, and remarks that this is less when the specimen tested is soaked in water. In natural circumstances in the earth's crust the crushing value of a column of rock, which would crush the layer at its foot, must be estimated by the weight of the material in water, and the author calculates that a column of sandstone must be from about two-thirds of a mile to five miles in height, one of granite from four to seven and a half miles, and one of felsite from seven to nine miles. The actual zone of mass deformation seems to be much nearer the surface, judging by the "creep" in mine-levels, and by the fact, in the case of deep bore-holes, that a cylinder of rock gradually rises from the bottom. The author alludes to the effect that crushing would produce along the bases of deep gorges, and he points out that the line of inquiry indicates that there must be a limit to the height of mountains and to the thickness of ice-sheets. He further discusses the deformation of rocks at great depths by the action of water.

In the *Proceedings* of the Royal Society of Victoria (n.s. vol. xvi. part i.), Mr. F. Chapman describes some new species of Silurian Polyzoa and Brachiopoda. Prof. J. W. Gregory discusses the formation of the Henty peneplain in N.W. Tasmania. In places it is 1300 feet or more above the sea, but is lower towards the north, west, and south. It appears to have been due to river-action in pre-Glacial times, when western Tasmania stood a few hundred feet lower than it does now. Its comparatively recent uplift is shown by the King River, which, east of Mount Lyell, flows through a very ancient flat-floored valley, and then traverses the peneplain in a sinuous narrow canyon.

An elaborate memoir on the Jurassic Trigoniæ of Cutch has been contributed by Dr. F. L. Kitchin to the *Memoirs* of the Geological Survey of India (Pal. Ind., ser. ix., vol. iii., part ii., No. 1). Most of the species of Trigonia have been obtained from the Putchum-Charee series, which, on the evidence of Cephalopoda, has been grouped with the European Bathonian, Callovian, and Oxfordian strata. In no case has Dr. Kitchin been able to identify any of the Cutch Trigoniæ with European species, but while they afford no definite evidence of the correlation above mentioned, they present no obstacles to its acceptance. They flourished in a different zoological province, but the Lower Charee (Callovian) forms bear the imprint of a facies which characterised a slightly earlier age in Europe, a fact suggestive of migration into the Cutch area. No Trigoniæ have been obtained from the Katrol (Kimeridgian) strata, but in the overlying Oomia beds, which appear to be transitional between Jurassic and Cretaceous, there are Trigoniæ that approximate in adult characters to forms found in the Uitenhage strata of South Africa. There is other evidence which suggests community between the Jura-Cretaceous faunas of the two areas, but as the forms in question differ widely in their youthful characters, Dr. Kitchin regards them as indicating homœomorphous derivation from separate stocks. Evolution of this character may have taken place under similar conditions, but it does not imply contemporaneity. The subject is of great im-

portance in the comparison of forms, in the naming of species, and in the correlation of strata by their aid. As the author points out, it demonstrates the necessity for abundant material in palæontological studies.

Mr. W. H. Dall has published a summary of the geological results of the study of the Tertiary fauna of Florida, 1886–1903 (*Trans.* Wagner Inst. Sci., Philad., iii., part vi.). He points out the objections to the method of grouping which was based by Lyell and Deshayes on the percentage of species that survive to the present day, as the conditions may be more favourable for the survival of species in one region than in another. The presence or absence of identical species in the Tertiary beds on either side of the Atlantic may be an important factor in correlation, but while this is partially true of older geological horizons, yet after the Mesozoic epoch the faunal characteristics of the shallow-water Mollusca of different regions became rapidly distinctive. Even in the Eocene but two or three species can be claimed as identical on both shores of the Atlantic, and in later periods it would be unreasonable to expect to find a series of identical species in subtropical marine invertebrate faunas in widely separated regions. In order to establish correlation, we should look for equivalent stages of evolution in relation to preceding and subsequent faunas, and not expect a greater number of identical species than are found in the contemporaneous faunas of distant areas at the present day. Mr. Dall adopts the grouping of Eogene to include Eocene and Oligocene, and Neogene to include Miocene and Pliocene, and he gives detailed lists of fossils. He discusses the physical changes that have taken place, and agrees that no discontinuity of the link between N. and S. America from the Miocene to the present time is probable, and certainly none amounting to a free communication between the two oceans.

A pamphlet on "Rock Phosphates and Other Mineral Fertilisers" has been issued by Dr. Charles Chewings (C. E. Bristow, Adelaide, S. Australia). The object is to give descriptions of the deposits from which mineral fertilisers originate, with notes on the preparation of the phosphate for the market, as an aid to the prospector and to others engaged in the practical applications of the manures. Particulars are given of phosphate deposits in all parts of the world, but special reference is made to those of Clinton, on Yorke's Peninsula, in South Australia. Here a range of hills, formed mainly of Cambrian rocks, rises to an elevation of nearly 400 feet, and beneath the crest, in a N.E. and S.W. direction, the rock phosphate occurs. It extends for more than 104 chains, varies in width from 8 to 20 chains, and is covered to a considerable extent by alluvial deposits. No fossils have been found in the deposit, and the author gives reasons for believing it to have been derived from guano. Selected samples can hardly be distinguished from the phosphate rock of Christmas Island.

According to Mr. E. O. Hovey (*Science*, November 13) the ascending obelisk of Mont Pelée, of which we reproduced an illustration from a photograph taken on June 13 (NATURE, October 1), has since disappeared. Meanwhile, the dome of the cone surmounting the crater has been greatly altered, and a small spine issued from it early in September. This was pushed up 20 metres within a week, and then destroyed by an eruption. Eruptions giving rise to great dust clouds led to the expectation that further serious disturbances might take place. The latest bulletins (October 1 to 19), however, indicate only feeble activity of the volcano.

We have received the subject list of works on the mineral industries and allied sciences in the Library of the Patent Office. This is a helpful guide to the literature of various subjects, and these are arranged under headings of which assaying, clay and clay industries, coal and coal mining, geology descriptive and applied, lead, limestone, peat, uranium and zinc may be taken as examples. The list is, of course, confined to the works in the Patent Office, and it contains titles of a few books and pamphlets that are worthless from a practical point of view, such as "King Coal's Levee" (1820). Institutions should have authority to part with works of this kind, so that they might be placed in appropriate libraries. The practical utility of the list is, however, great, and the price is only 6*d*.

Some Jurassic fossils from Borneo have been described by Mr. R. Bullen Newton (*Proc.* Malacol. Soc., v., October). These include a new species of Trigonia (*T. Molengraaffi*), the genus being recorded for the first time from the rocks of Borneo. The characters of the fossils indicate that the strata belong to the Lower Oolites.

In some notes on the origin of coral reefs (*Amer. Journ. Sci.*, September) Mr. J. Stanley Gardiner remarks that while some reefs may possibly owe their existence to the subsidence of the land round which they originally formed only a fringe, yet the facts collected during recent years prove that such a method of formation was rare and exceptional. Referring to the Maldive group, he shows that a study of the reefs indicates the following stages:—(1) a basis of primitive rock cut down by the action of currents, &c., and lying at a depth of about 200 fathoms in a sea of more than 2000 fathoms; (2) upgrowth of a shoal by means of deep-sea corals assisted by other organisms; (3) outward extension of the reef by means of detritus; (4) surface reef formed by corals, &c.; (5) land, formed by piling up of sand and rubble on the reef; and (6) lagoon, formed partially by the more rapid growth of the organisms on the edge of the original bank, building up an encircling reef, and partially by the solution and erosion of the central parts.

BIOLOGICAL TREATMENT OF SEWAGE.

FOR some years a very interesting series of experiments in connection with the biological method of sewage treatment has been carried on by Dr. Dunbar, director of the Hygienisches Institut at Hamburg, and by his colleagues. Special attention has been directed to the elucidation of the sequence of changes which underlies the purification process in contact beds and percolating filters.

The most recent conclusions are given in a paper read by Dr. Dunbar at the International Congress of Hygiene and Demography at Brussels, and in several papers in the *Gesundheits-Ingenieur*, more especially in one by Messrs. Kattein and Lübbert in No. 25 of that journal. Great importance is attached by the Hamburg workers to the *rôle* played by the process of so-called "absorption" which takes place when the liquid is in contact with the purifying medium. It has been found that sterile clinkers have the power of withdrawing from solution not only colouring matters, but also the highly complex nitrogenous bodies found in sewage.

The exact meaning to be given to the term absorption is carefully discussed by Kattein and Lübbert in their paper, with copious references to the literature of the subject. It is defined as a purely surface action independent of chemical attraction, analogous, in fact, to the condensation of carbonic acid on glass threads observed by Bunsen.

The purification of the sewage by the ordinary biological methods is considered, in the first place, to be due to the "absorption" by the medium of the putrefactive matters in solution, which are afterwards oxidised through the intervention of micro-organisms. Without the activity of the organisms in presence of oxygen, absorption soon ceases.

The absorptive effect increases with the surface exposed, *i.e.* with the fineness of the material. Very considerable reduction of impurities can be effected by a contact of a few minutes, and the effect practically attains its maximum in from four to six hours.

Besides the destruction of the absorbed organic matter, which is due to micro-organisms, some oxidation is effected directly by the atmospheric oxygen, which is also absorbed, and which is shown to be in a specially active condition, as it is capable of instantly oxidising hypochlorites to chlorates, and, more remarkable still, of converting dimethyl-aniline into methyl-violet. The last change can only be brought about in the ordinary way by heating with chlorate, or other powerful oxidising agent.

An interesting example of absorption is seen in the case of the percolating filter adopted by Dr. Dunbar. This filter is provided with a layer of fine material on the surface, about six inches deep. According to Dr. Dunbar, 50 per cent. of the purification, apart from nitrification, takes place in this six inches.